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Background

- There exists a need to understand factors that support attention in naturalistic settings, like classrooms, especially for children with ADHD.
- The alpha-band oscillations show large group effects related to working memory-deficit ADHD.
- But correlations between alpha and academic performance are low (Lenartowicz et al., 2014; Lenartowicz et al., 2019).
- Why?* We need to study attention deficit in natural environment.

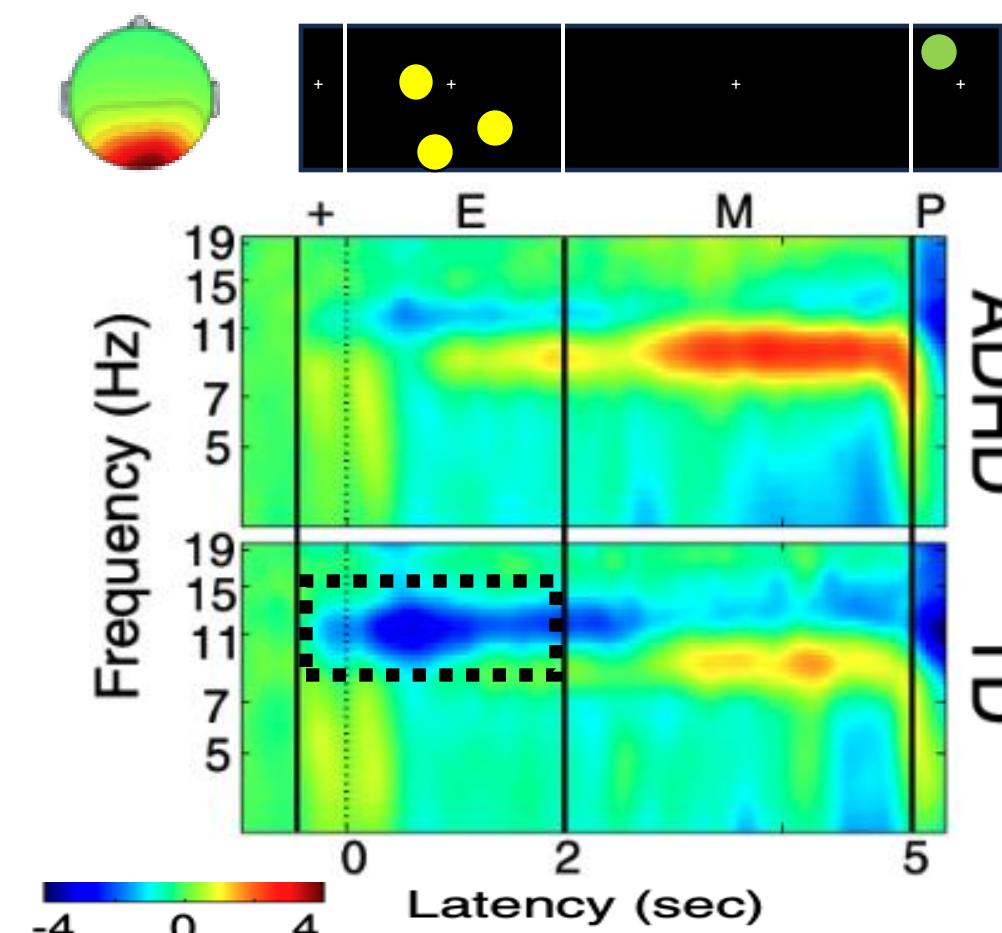


Figure 1.(left)
Alpha ERD (event-related desynchronization) decreased during encoding in both TD and ADHD groups (Lenartowicz et al., 2014).

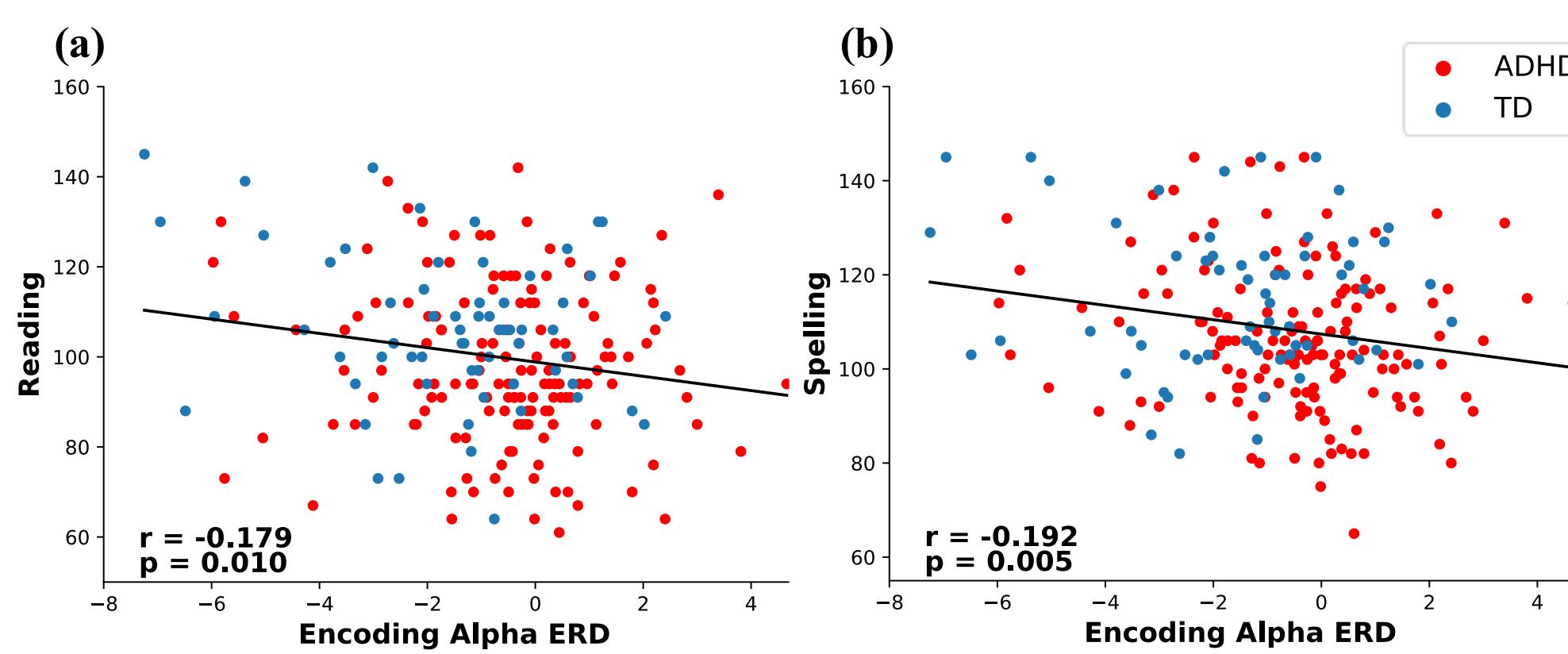


Figure 2. Correlations between (a) reading and (b) spelling with encoding alpha ERD.

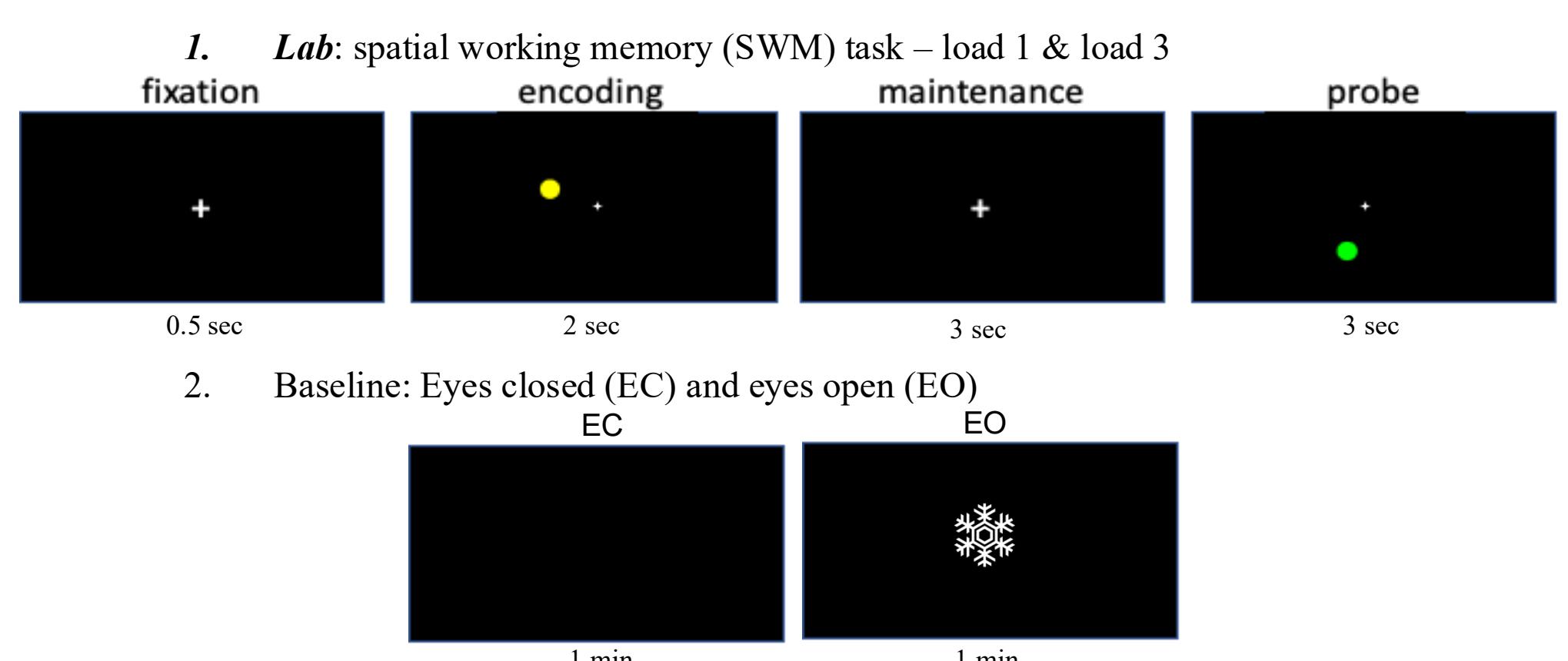
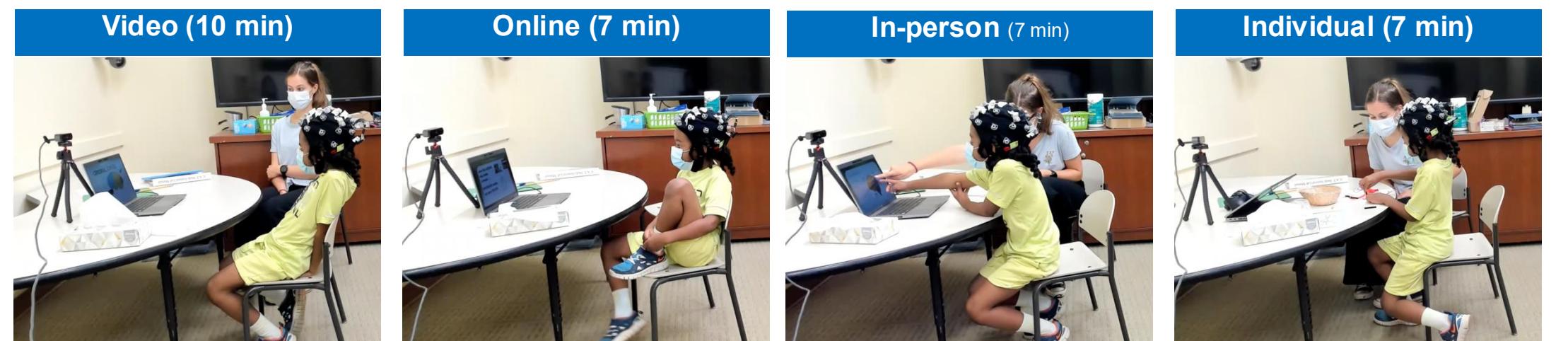
Research Questions

- Does instructional context affect attention?
- Does this differ for children with ADHD?
- How does lab task performance correlate with attention measured during learning activities?

Methods

- Participants:** 55 children (age: 8.5 yr; M:F = 30:25; ADHD = 13)
- EEG data:** digitized at 250 Hz using Smarting MOBI with a 24-channel saline cap
- EEG recording:**

- Naturalistic:** four learning activities with different learning modalities with an instructor



- EEG analysis:** FOOOF Python was used to extract alpha power (9-10 Hz) in the posterior (O1, Poz, O2) cluster for naturalistic, lab, and baseline EEG data.

Results

1.1 Naturalistic: Learning Activities

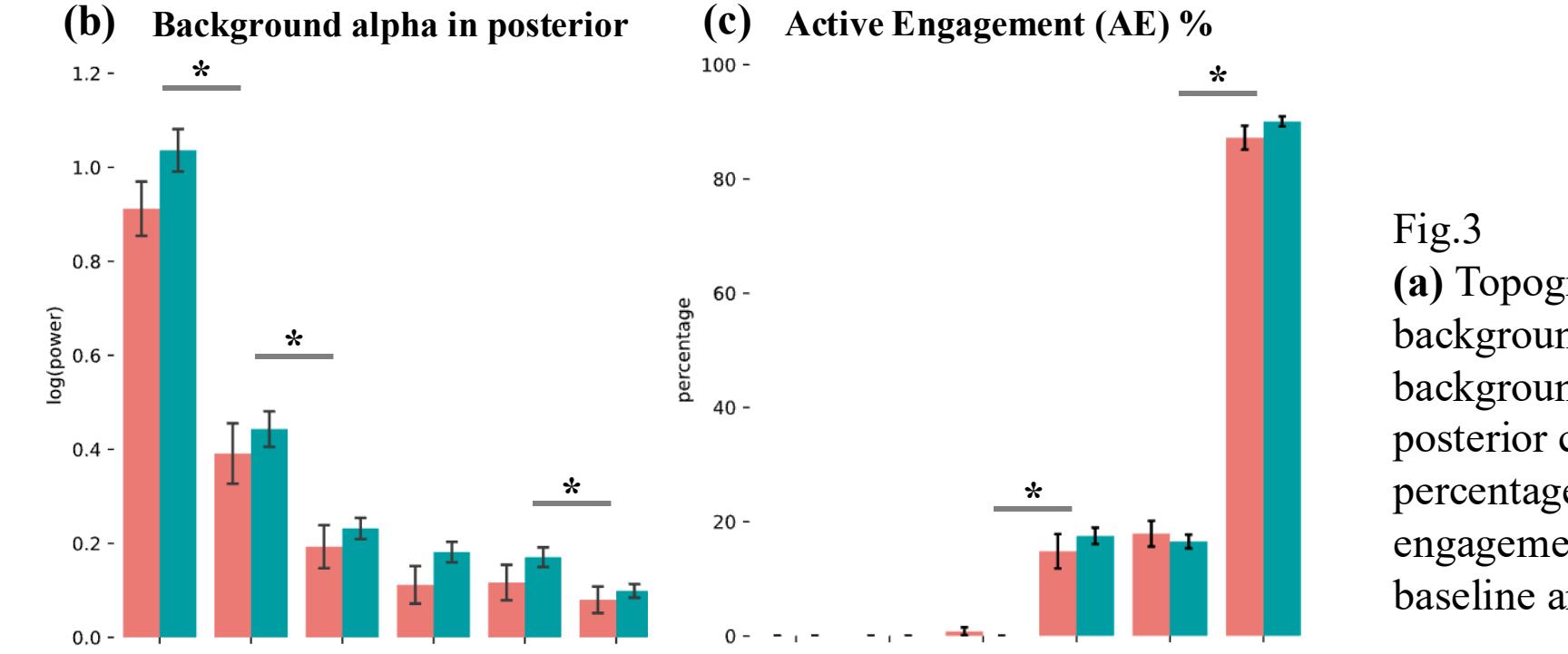
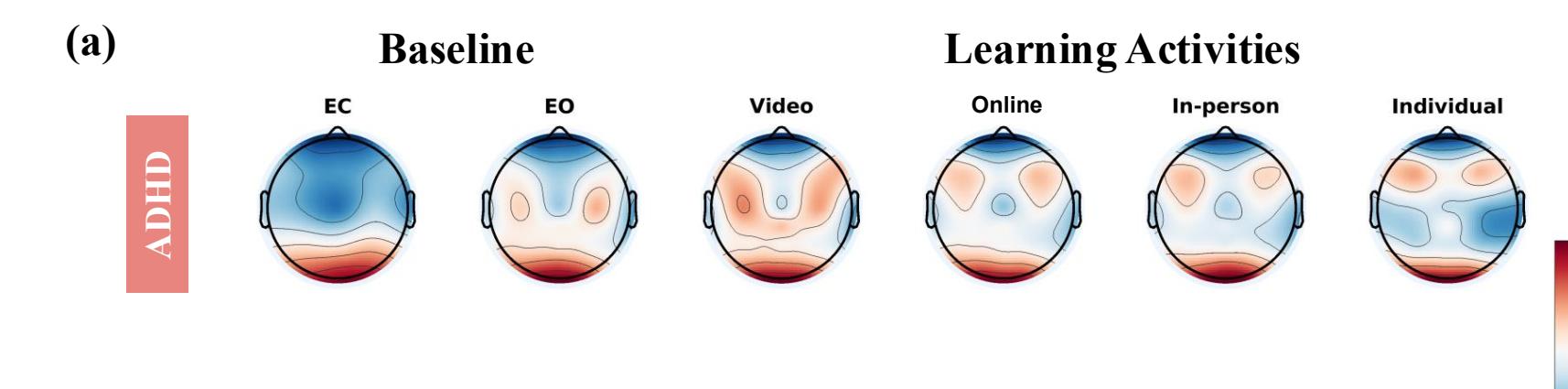
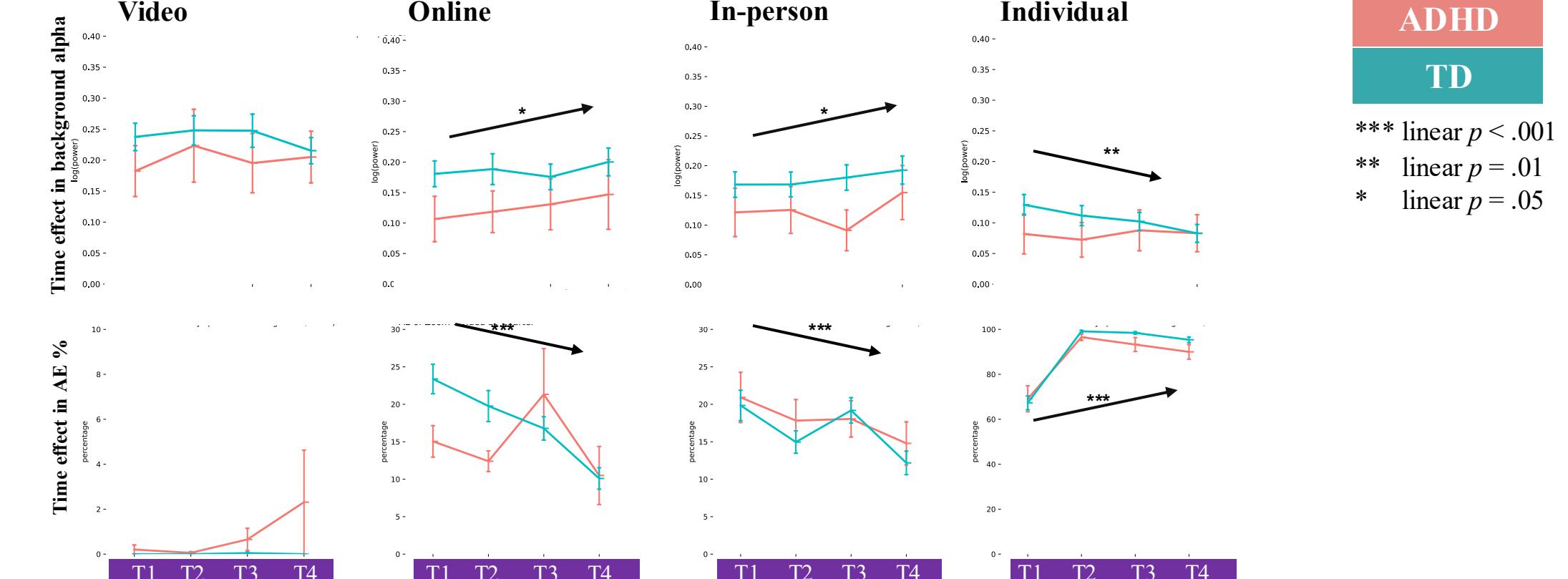


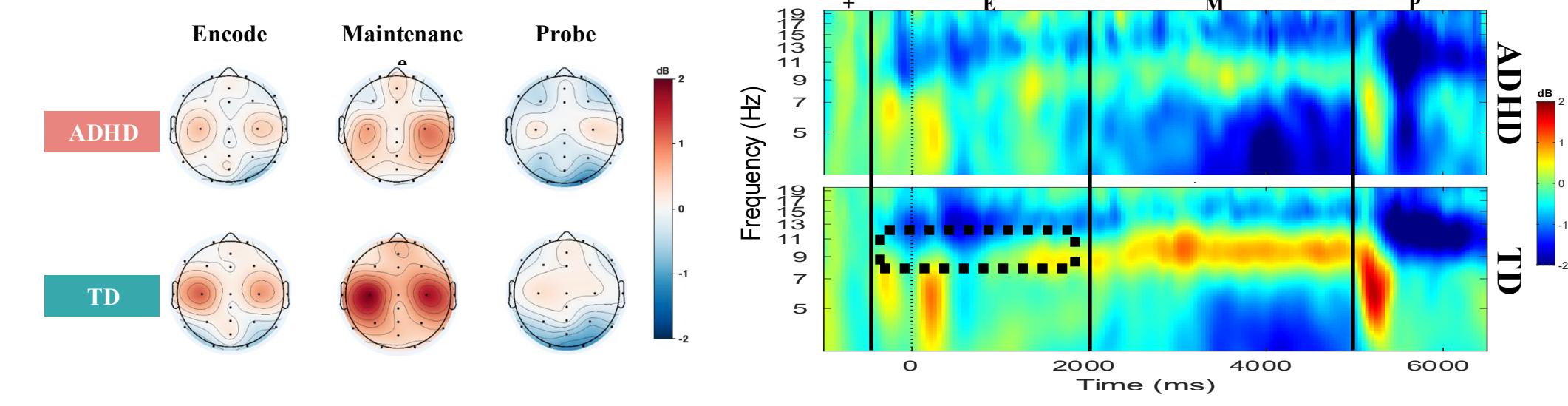
Fig.3
(a) Topography of the background alpha; (b) the background alpha of the posterior cluster; (c) the percentage of active engagement (AE%) during baseline and activities.

Results (cont.)

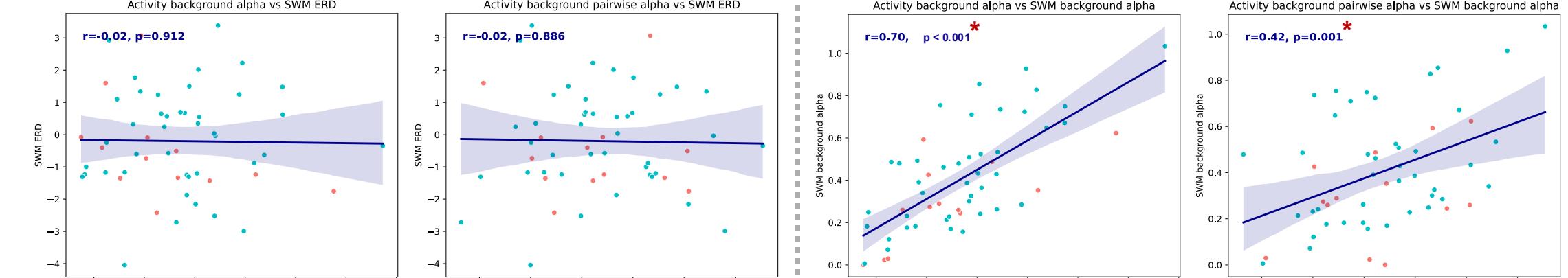
1.2 Naturalistic: Learning Activities – Time Effect



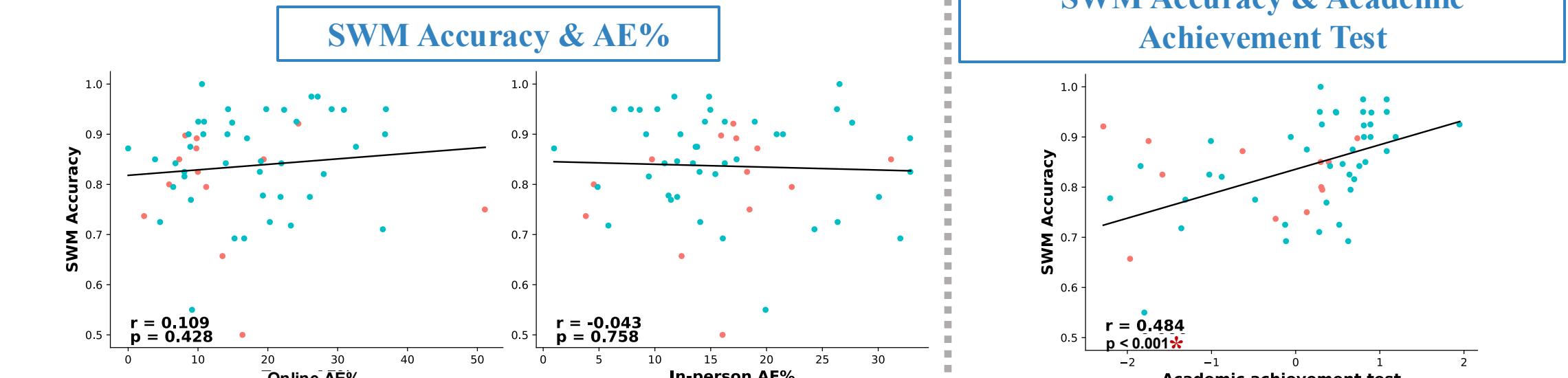
2. Lab: Alpha ERD during SWM



3. Correlations of Activity – SWM EEG



4. Correlations of the Behavioral Data



5. Regressions

(Model 1) Predicted outcome ~ SWM EEG power + SWM EEG ERD + covariates (symptom, sex, age)										Model fit		
	Alpha _b	Alpha _a	Alpha _m	Alpha _i	ERD _b	ERD _a	ERD _m	Age (yr)	Sex	Symptom	R ² _{adj}	F
Accuracy	0.881	-0.545	1.159	-0.520	1.651	-2.043*	1.403	-2.028*	2.733**	5.582***	0.291	3.213**
RT mean	-0.211	-0.945	0.989	1.280	0.777	-0.366	-0.703	0.777	-0.479	0.287	1.767	
RTEv	-0.364	-0.602	0.878	1.271	-0.450	-1.081	-1.749	-1.542	-0.378	-0.253	-0.024	0.874
(Model 2) Predicted outcome ~ SWM EEG power + SWM EEG ERD + covariates (symptom, sex, age)										Model fit		
	Alpha _b	Alpha _a	Alpha _m	Alpha _i	ERD _b	ERD _a	ERD _m	Age (yr)	Sex	Symptom	R ² _{adj}	F
Attention	1.329	0.874	1.052	-2.043*	1.403	-2.028*	2.733**	5.582***	0.723	0.275	0.411	4.765***
Fidgeting	-0.860	-1.209	-0.592	1.574	-1.104	1.526	-2.489*	-5.431***	-1.050	-0.133	0.378	4.285***
Off-task	-1.926	1.033	-1.842	2.059*	-1.335	2.175*	-1.386	-1.594	1.034	-0.987	0.128	1.791

Note: RT = reaction time, RTEv = coefficient of variation of reaction time, alpha = background alpha, m.e = encode, m.l.e = maintenance, p.l.e = probe. Factor loadings that exceed .3 are highlighted in bold.

Conclusion

- Instructional context has a significant effect on attention and behavioral engagement during learning activities, regardless of ADHD diagnosis.
- Laboratory measure may be narrowly capturing visual encoding during SWM, but this is not related to the behavior we associated with attention in natural activities, whereas the continuous alpha power capture background processes that are related to natural behavior.